RCRA FACILITY INVESTIGATION REPORT
RMI SODIUM PLANT
ASHTABULA, OHIO

VOLUME 1

RMI COMPANY
Niles, Ohio

ECKENFELDER INC.
June 1990

RCRA FACILITY INVESTIGATION REPORT
RMI SODIUM PLANT
ASHTABULA, OHIO

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EXECUTIVE SUMMARY

This report presents the results of a RCRA Facility Investigation (RFI) of the RMI Sodium Plant site located in Ashtabula, Ohio. Pure elemental sodium is produced at the plant in electrolytic cells. In early 1987, the Sodium Plant received a final Resource Conservation and Recovery Act (RCRA) hazardous waste management operating permit from the USEPA Region V. This permit allows RMI to continue to store and treat hazardous waste at the facility. In its RCRA permit, the RMI Company is required to prepare a Work Plan for and to conduct a RCRA Facility Investigation (RFI) at its Sodium Plant facility. The RFI is required in order to determine the nature and extent of releases, if any, from previous and existing solid waste management units (SWMUs) at the plant and to indicate whether site contamination is the result of off site migration onto RMI property. A Health and Environmental Assessment (HEA) will be included in the Corrective Measures Study (CMS) report to be later submitted per USEPAs request.

RMI's RCRA hazardous waste management operating permit for the Sodium Plant identifies five SWMUs. However, subsequent revisions identify ten SWMUs at the site. Of the ten previous and active SWMUs identified, seven were included in the RFI Work Plan approved by USEPA. These seven SWMUs are the closed landfill (Area A), the fill area northeast of the closed landfill (Area B), the fill area northwest of the closed landfill (Area C), the former fill areas in the vicinity of the wastewater treatment ponds (Area D), the wastewater treatment ponds (Area E), the fill areas west of the wastewater treatment ponds (Area F), and the fill area north of the wastewater treatment ponds (Area G).

Materials that have been deposited at the plant property include cell bath waste, anode butts, and miscellaneous solid waste including electrolytic cell construction materials and salt dissolver sludge. The principal hazardous constituents associated with the site are barium (Ba), cadmium (Cd), and lead (Pb).

RMI Company retained ECKENFELDER INC. (formerly AWARE Incorporated) to prepare the Work Plan and to conduct the RFI project. The RFI Work Plan was submitted to the agencies in June 1987. In late March 1988, USEPA approved the Work Plan (with minor modifications) and directed RMI to proceed with the RFI.

SUMMARY OF FIELD WORK

The scope of work of the RFI field investigation conducted at the site is described in detail in the approved "Work Plan for RCRA Facility Investigation, RMI Sodium Plant, Ashtabula, Ohio" (ECKENFELDER INC., June 1987). The scope of work was subsequently updated during the RFI field investigation and is described in the "Interim Report, RCRA Facility Investigation, RMI Sodium Plant, Ashtabula, Ohio" (ECKENFELDER INC., July 1988).

The first project work task consisted of the compilation and review of existing information with respect to the project site. This included historical aerial photographs, topographic maps, and reports. Historical aerial photographs of the RMI Sodium Plant were reviewed in order to locate solid waste management units (SWMUs) and their approximate periods of operation. In addition, the aerial photographs were reviewed to determine past surface water drainage patterns and land uses of the site and surrounding areas. A site topographic map for the project area was obtained from RMI Company. This map was used to provide a consistent data base and depicts topography with 2 ft contour intervals and shows major site features including monitoring wells, boring locations, ponds, drainage ditches, roads, etc. Additionally, the elevations of all piezometers, monitoring wells, and staff gauges were measured by a licensed surveyor.

A surface geophysical survey was conducted over four primary areas of known or suspected waste disposal activities at the RMI plant site. The survey was employed to define the areas of past waste disposal, and possibly, their effects on groundwater and soil conditions. The geophysical survey utilized both terrain conductivity and earth resistivity methods.

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Surficial soil sampling was conducted in five areas of the RMI Sodium plant: the fill area north of the wastewater treatment ponds (Area G), the fill area west of the wastewater treatment ponds (Area F), the fill area northeast of the closed landfill (Area B), the fill area northwest of the closed landfill (Area C), and the closed landfill (Area A). Four surficial soil samples were collected at each location; 12 background samples were also collected. The results of the surficial soil analyses were evaluated for statistical significance relative to background concentrations, per the request of USEPA.

Twenty piezometers were installed at key locations throughout the site to provide a definition of groundwater flow patterns. Data obtained from the piezometers were used to identify locations of soil borings and monitoring wells. Eighteen soil borings were advanced to recover soil at various depths at locations of indicated past waste disposal, adjacent to such waste disposal areas, or in background areas. Soil borings were either converted to shallow monitoring wells, deep bedrock monitoring wells, or grouted to land surface. Some soil samples collected from the borings were analyzed for various parameters.

Ten shallow monitoring wells were installed to provide information on the water table surface and the water quality in the glacial till water-bearing zone. Five deep monitoring wells were installed to provide information on the piezometric surface and the water quality in the bedrock water-bearing zone. Water level measurements and in situ hydraulic conductivity tests were utilized to determine groundwater flow regimes at the site. Groundwater was sampled and analyzed during two episodes from each monitoring well.

Water samples were collected from the wastewater treatment ponds, french drains, and the drainage ditches. Sediment samples were also collected from the ponds. These samples were analyzed for various chemical parameters.

CONCLUSIONS OF THE INVESTIGATION

Site geologic conditions were determined to correlate quite well with regional reports. Groundwater has been observed to occur within two zones beneath the RMI site:

1. An unconfined water table zone within the fill and upper glacial till with moderate hydraulic conductivity and within the deeper unweathered glacial till with presumed lower hydraulic conductivity. In general, the groundwater is mounded around the ponds at the site and the overall groundwater flow directions radiate outward from the site; and

2. A confined water-bearing zone within the lower hydraulic conductivity shale. Based upon piezometric surface data and, consistent with the geologic literature, the horizontal flow of groundwater in the shale is toward the north to Lake Erie.

It is demonstrated that the uppermost water-bearing zone (or that in the glacial till) in the vicinity of the RMI Sodium Plant should be classified as Class IIIA groundwater in accordance with the USEPA Groundwater Protection Strategy. A Classification Review Area (CRA) was defined and subdivided into two groundwater units: the uppermost water-bearing zone in the unconsolidated glacial till deposits and the underlying bedrock water-bearing zone in the Chagrin Shale. These two groundwater units were subdivided on the basis of a "Type 3" boundary (permanent fresh water-saline water contact). Because it was determined that the bedrock unit is not affected by activities at the RMI Sodium Plant, it was not included in the groundwater classification procedure. Information regarding the presence and usage of domestic and municipal wells and the presence of federal endangered species or critical habitats in the CRA was also compiled. Yield calculations for the glacial till zone were performed and it was determined that groundwater in the glacial till zone in the vicinity of the RMI Sodium Plant meets the requirements of a Class IIIA groundwater on the basis of insufficient yield.

On site surface water drainage patterns indicate that a runoff divide exists within the main process area of the plant site. Water falling south of the divide will generally be intercepted by ditches which flow to the west and south, discharging into the DS Tributary of Fields Brook. Water falling north of the divide will flow off site to the north and, presumably, ultimately into Lake Erie.

Constituents present in the environmental media on the RMI site are interrelated through a variety of potential release mechanisms and migration pathways. These potential release mechanisms and migration pathways will be addressed in the HEA section of the CMS report. The findings and explanations for the presence of site constituents in the media sampled at the RMI site are briefly described in the following paragraphs.

Air

No measurements of total organic vapors and gases in ambient air above background levels were observed during field activities. Although no air monitoring has been conducted for metals, it is possible that trace quantities of metals sorbed onto the surficial soils may migrate via fugitive dust. This potential migration pathway will be further discussed in the HEA section of the CMS report.

Groundwater

Elevated (with respect to background conditions) concentrations of Ba and Cd in shallow groundwater have been detected on site, particularly in the areas north (Area G) and east of the wastewater treatment ponds (Area D). The highest concentration of Ba detected in groundwater was 1900 ppb, in well 8S near Area G; the highest concentration of Cd was 25.7 ppb, near Area D. The presence of these constituents in groundwater is believed to be due, in part, to recharge of the groundwater from the wastewater treatment ponds, and most likely not from the leaching of subsurface soils or buried wastes.

The direction of contaminant migration in shallow groundwater appears to radiate outward from the site. The shallow groundwater ultimately discharges to the DS tributary of Fields Brook in the vicinity of the closed landfill, and to the drainage ditch east of the five ponds. However, because the drainage ditches are shallow and do not intercept the entire water table zone, contributions of constituents from shallow groundwater to surface water ditches are expected to be minimal. The rate of Ba and Cd migration in the shallow groundwater is believed to be primarily controlled by the high sorption potential of the barium and cadmium ions. The rate of contaminant migration, potential release mechanisms, and migration pathways will be addressed in the HEA section of the CMS report.

The concentrations of metals measured in the shale groundwater zone are at background levels. Barium was the only metal consistently detected in the bedrock groundwater wells and it occurred at concentrations greater than the shallow groundwater background values. However, the presence of Ba in the deep bedrock groundwater does not necessarily indicate a connection with the SWMUs on site. Based upon the low permeability and considerable thickness of the unweathered glacial till, and the relatively small hydraulic gradient between the bedrock and the shallow aquifer, it is apparent that only a minimal downward component of flow exists between the two water bearing zones. In addition, major ion data demonstrate that the bedrock groundwater has a distinctively different chemistry than the shallow groundwater. Barium/chloride ratios in the deep and shallow aquifers are also inconsistent with the hypothesis that the deep groundwater had been impacted by the shallow groundwater. Barium in the deep groundwater occurs at higher concentrations than shallow groundwater, while chloride concentrations in the deep groundwater are much lower than in shallow groundwater. These inverted ratios indicate that the barium in the deep groundwater is naturally occurring. Therefore, water quality in the bedrock groundwater is not affected by the SWMUs on site.

Soils

Both surficial and subsurface soils were collected at various locations on the RMI plant site. Surficial soil samples were analyzed for nine inorganic parameters. A statistical test (Student's t test) was applied to the surficial soil data to assess the significance of the differences in means found between samples from background and test areas. Compared to background concentrations, Ba, Cd, Pb, nickel (Ni) and arsenic (As) in Area B; Ba, As, Pb, and selenium (Se) in Area C; Ba, Cd, Pb, Ni, and As in Area F; and Ba, Cd, chromium (Cr), Ni, and As in Area G were determined to be present in surficial soils at elevated concentrations. A priority pollutant scan was also conducted on one sample. No volatile organic, acid extractable, or base neutral compounds, pesticides, PCBs, phenols, or cyanide were detected.

Subsurface soil samples were analyzed for nine inorganic parameters as well as total cyanide. The subsurface soils which showed elevated concentrations were determined to be: Area D, between 3.0 and 6.5 ft for Ba, Pb, and Ni; and Area G for Pb, Cd, and Ni at depths less 6.5 ft. When comparing subsurface soil data with surficial soil data, it is apparent that the SWMUs in the vicinity of the ponds (Areas D, F, and G) were used as fill areas and the SWMUs in the vicinity of the closed landfill (Areas B and C) were used as temporary surficial storage zones for material that was later placed into the landfill. Priority pollutant scans were conducted on three samples. Volatile organic, base neutral, and acid extractable compounds were detected only in the vicinity of the DNAPL, which originates from an off site source (further discussed below). Two samples exceeded the EP Toxicity Equivalent for lead and cadmium (the respective MCL multiplied by 20, which was used to screen samples for EP toxicity testing). However, when EP Toxicity tests were performed on these samples, it was determined that they were not EP Toxic.

Surface Water

Samples were collected from the wastewater treatment ponds, the french drain system, and the site drainage ditches. Barium and Cd were found in all of the ponds, with Ba in the highest concentrations in both the pond water (at 5,500 ppb in Pond 3) and pond sediments (3,020 ppm in Pond 4). Barium appears to be the only parameter detected in the pond sediments at elevated concentrations. The concentrations of constituents in the french drain samples were substantially lower than the pond water samples, with Cd at 26.8 ppb being the highest constituent level detected. Very low concentrations were found for most constituents in the ditch samples; the highest levels detected were: zinc (Zn) at 359 ppb at DW-E (and at 77 ppb at DW-G) and Cd, at 37.9 ppb at location DW-B. Because of the location of DW-E (of the southeast corner of the property, where the ditch originates from off site), it is believed that the Zn could be attributed to an off site source to the east. The concentration of Cd at location DW-B is believed to be the result of the presence of suspended sediment in the water sample which likely originated from the erosion of surficial soils from Area B. Although the presence of organics was indicated from the results of priority pollutant scans (conducted on samples DW-E and DW-G), the presence of organics is believed to be due to sources originating off site.

OFF SITE SOURCE(s)

A dense non-aqueous phase liquid (DNAPL) comprised of chlorinated solvents and associated dissolved constituents found on the RMI site is believed to be the result of an off site source located to the south. This conclusion is based on the fact that RMI does not and has never used chlorinated solvents at the Sodium Plant. This is supported by the observation that the major portion of the sandy till zone which contains the DNAPL occurs to the south of the RMI site, and the piezometric surface of the DNAPL-saturated sandy till has not been observed anywhere except the extreme southern boundary of the RMI site. In addition, dissolved organic constituents from the DNAPL have only been observed in the immediate vicinity of the southern boundary of the RMI property. A chemical manufacturing facility, located on the southern border of the site, has historically discharged chlorinated solvents to Fields Brook and unlined settling lagoons on their property. Therefore, sufficient information has been collected to concluded that the DNAPL source is off site to the south.

RECOMMENDATIONS

Based upon results of the RCRA Facility Investigation, it is recommended that supplemental investigations be undertaken at the RMI Sodium Plant site. These further investigations should include the following:

TASK 1: ACID TANK INTEGRITY TESTING

An integrity assessment should be performed on the sulfuric acid neutralization tank system. The sulfuric acid neutralization system is part of the NPDES treatment system at the RMI Sodium Plant. This assessment would determine if the tank system has potential for causing releases.

TASK 2: DEEP WELL WATER LEVELS

Water level measurements should be collected in all deep wells (4D, 5D, 7D, 9D, and 11D) because water levels had not fully recovered in several bedrock wells during the RFI. The water level data would be used to further assess the piezometric surface of the bedrock groundwater and direction of bedrock groundwater flow.

TASK 3: EASTERN BOUNDARY CHARACTERIZATION

Based upon the results of the RFI, further investigation of the area east of the wastewater treatment ponds is warranted. This study should include the following:

- Installation of 2 to 3 temporary piezometers to further define groundwater flow characteristics in this area. These piezometers should be shallow (less than 10 ft deep) and should be located between the wastewater treatment ponds and the off site drainage ditch located to the east of the ponds.

- Installation of at least two staff gages in the eastern drainage ditch to better define surface water flow characteristics in this area. In addition, the information could be used to determine the relationship between surface water and groundwater in this area.

- Installation of 1 to 3 monitoring wells to define groundwater flow patterns and assess groundwater quality. The wells should be installed between the wastewater treatment ponds and the off site drainage ditch located to the east of the ponds and should be completed within the glacial till (less than 15 ft deep).

- Water levels should be measured in all proposed and existing wells, piezometers, and staff gages; and a site-wide groundwater contour map should be constructed.

- Groundwater and surface water should be sampled in the eastern boundary area and analyzed for priority pollutant metals and cyanide. This information would better define water quality in the area.

TASK 4: TEMPORARY PIEZOMETER ABANDONMENT

All existing and proposed temporary piezometers should be abandoned following the conclusion of Tasks 1, 2 and 3.

TASK 5: PREPARATION OF SUPPLEMENTAL INVESTIGATION REPORT

A Supplemental Investigation Report should be prepared, as a stand-alone document, and incorporate the findings of Tasks 1 through 4. This report would be submitted to the USEPA and approved prior to issuance of the final CMS report.

1.0 INTRODUCTION

RMI Company operates three manufacturing facilities in Ashtabula, Ohio: the RMI Metals Plant, RMI Extrusion Plant, and the RMI Sodium Plant. The RMI Sodium Plant is the subject of this investigation. Pure elemental sodium is produced at the plant in electrolytic cells. In early 1987, the Sodium Plant received a final Resource Conservation and Recovery Act (RCRA) hazardous waste management operating permit from the USEPA Region V. This permit allows RMI to continue to store and treat hazardous waste at the facility. In 1986, the USEPA and the Ohio EPA made a tentative determination that a release of hazardous constituents to the groundwater at the RMI facility had occurred from units other than the active hazardous waste management facilities.

In its RCRA permit, the RMI Company Sodium Plant is required to prepare a Work Plan for and to conduct a RCRA Facility Investigation (RFI). The RFI is required in order to determine the nature and extent of releases, if any, from previous and existing solid waste management units (SWMUs) at the plant or to indicate whether site contamination is the result of off-site migration onto RMI property. The RFI Work Plan was prepared by ECKENFELDER INC. (formerly AWARE Incorporated) and submitted to the agencies in June 1987. The RFI Work Plan included ten tasks:

- Task 1: Collection and Interpretation of Existing Information
- Task 2: Geophysical Surveys
- Task 3: Soil Borings
- Task 4: Shallow Monitoring Well Completion
- Task 5: Deep Monitoring Well Completion
- Task 6: Monitoring Well Sampling and Testing
- Task 7: Surficial Soils Sampling
- Task 8: Pond and Surface Water Sampling
- Task 9: Progress Report
- Task 10: RFI Report

In late March, 1988, USEPA approved the Work Plan (with minor modifications) and directed the company to proceed with the RFI.

Each of the above tasks were performed by ECKENFELDER INC. using the guidelines presented in USEPA's Interim Final RCRA Corrective Action Plan (June 1988) and the draft RCRA Facility Investigation (RFI) Guidance Document (July 1987), and in accordance with USEPA's 3004(u) policy. Tasks 1 through 8 were commenced upon approval of the RFI Work Plan. In July 1988, the "Interim Report, RCRA Facility Investigation" was issued to fulfill Task 9. This report included the results of the geophysical survey, proposed amendments to the Work Plan, and clarified certain field methodologies. The proposed amendments were approved verbally by USEPA. However, in September 1988, changes to the proposed amendments were requested by the USEPA including reconsidering the use of Teflon® or stainless steel wells (as opposed to PVC as suggested in the Interim Report) in areas where organics have been detected in groundwater. In addition, it was requested that broader metal scans be conducted at additional locations at the site. A more statistically rigorous development of background metals levels was also requested for surficial soils at the site. These changes were agreed upon and procedures were conducted as requested.

This report summarizes the results of the RFI. Included in this report are the following:

- a discussion of the Sodium Plant site history
- a discussion of the field methodologies used during the RFI
- a presentation of the site environmental setting including geology and hydrogeology, soils, surface water and sediment, climatological conditions, and demography and land use
- a characterization of sources of potential releases
- an assessment of the potential for contaminant release

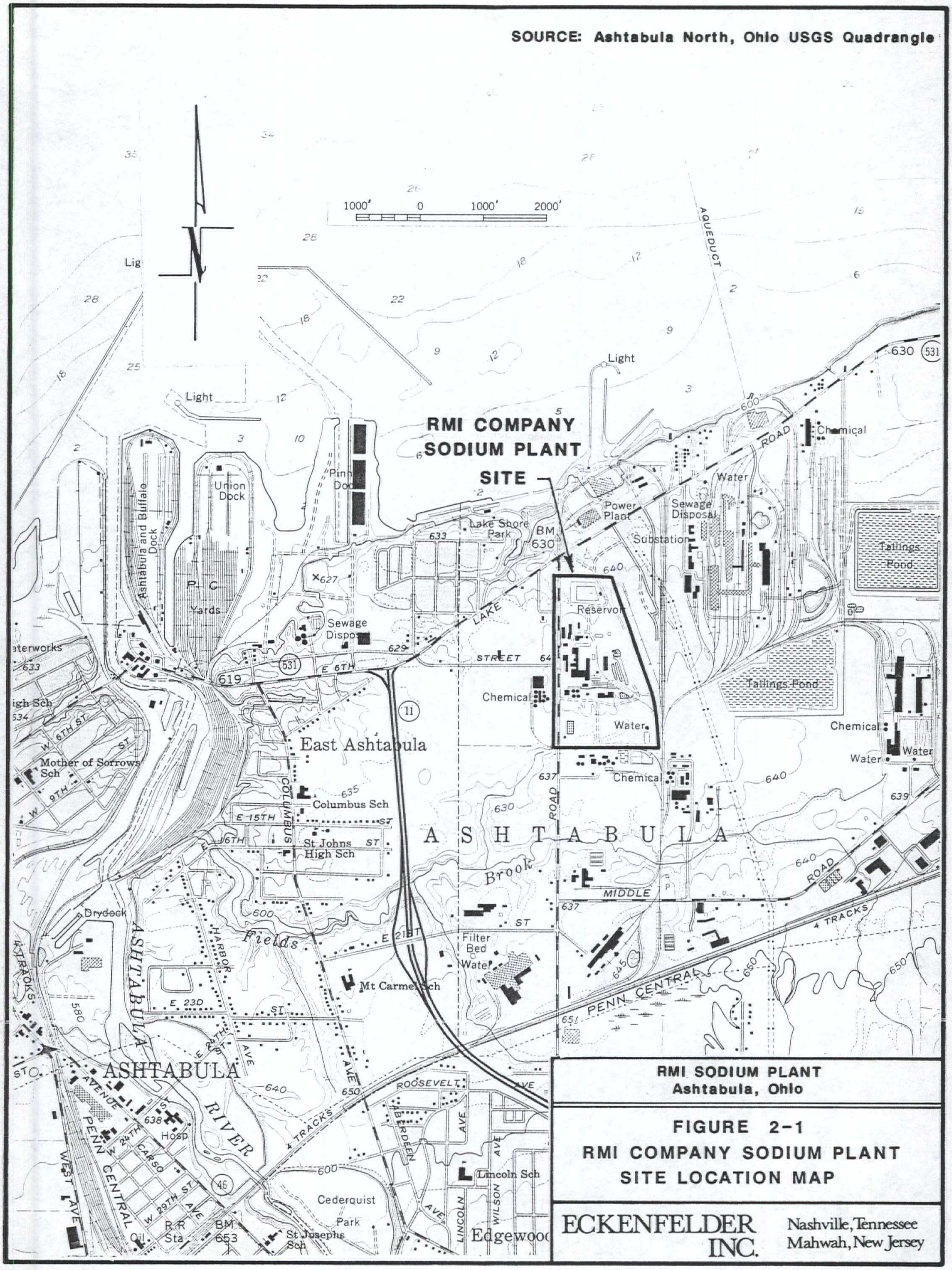
2.0 SITE DESCRIPTION AND HISTORY

2.1 SITE HISTORY

The Sodium Plant was originally developed under a licensing agreement between National Distillers Products Corporation and E.I. DuPont de Nemours, the licensor, from 1948 through 1950. In 1949, the National Distillers Chemical Corporation (NDCC) was incorporated as a wholly-owned subsidiary of the National Distillers Products Corporation (NDPC) for the purpose of chemical (sodium and chlorine) production and manufacturing. NDPC operated the Sodium Plant until 1951 when NDPC merged with the U.S. Industrial Chemicals Company and became an operating division of that company. In the same year, NDCC was dissolved and became a part of U.S. Industrial Chemicals. In 1964, National Distillers and U.S. Steel (now USX) entered into a partnership agreement for the operation of the Sodium Plant and the other Ashtabula facilities under the corporate name of Reactive Metals, Incorporated. In 1971, Reactive Metals Inc. was redesignated the RMI Company.

Prior to the initial acquisition of land parcels in the late 1940s, it is believed that no chemical manufacturing or processing was conducted at the site. The sources of this information were RMI Company's CERCLA 104 Response for the Fields Brook site, interviews with past and present employees, and historical aerial photographs. The land upon which the Sodium Plant was developed was purchased from the Cleveland Electric Illuminating Company and miscellaneous private landowners from 1948 to 1950. The land was used as an easement when owned by Cleveland Electric Illuminating Company and other areas owned by miscellaneous owners were idle or used for non-industrial purposes.

RMI has operated this facility for the manufacture of metallic sodium and chlorine while operating under both the National Distillers Products Corporation and US Industrial Chemicals Company. In addition to sodium and chlorine, sodium peroxide was intermittently produced from 1950 to 1979. No other products have ever been manufactured at the RMI Sodium Plant. A site location map (Figure 2-1) identifies the approximate location of the Sodium Plant. The facility is located adjacent to the intersection of State Road and East Sixth Street in Ashtabula, Ohio.



RMI SODIUM PLANT
Ashtabula, Ohio

FIGURE 2-1
RMI COMPANY SODIUM PLANT
SITE LOCATION MAP

ECKENFELDER INC. Nashville, Tennessee Mahwah, New Jersey

2.2 GENERAL FACILITY DESCRIPTION

RMI produces sodium and chlorine by the electrolysis of sodium chloride in Downs cells. These cells are closed, refractory lined, steel vessels which receive solid sodium chloride as a raw material. Calcium chloride is added to lower the melting point of the sodium chloride. An electrical potential is applied to the cell which initiates electrolysis. After the electrolysis cycle is complete, the product sodium is removed at the cathode. The chlorine gas is collected at the anode. The sodium is then filtered to increase purity to 99.9 percent. The chlorine gas is liquefied prior to shipment. Raw materials used at the plant include sodium carbonate, calcium chloride, barium chloride, sulfuric acid, hydrochloric acid, sodium hydroxide, cobalt chloride, sodium bisulfite, lime, and aqueous sodium chloride brine solution. Weak brine is imported from the nearby RMI Metals Plant and is concentrated through a solution mining process in which weak brine is injected into a salt bearing strata, recovered in concentrated form, purified, and then evaporated and dried. Since 1985, a portion of the refined salt has been sold for industrial uses. Prior to 1985, rock salt was purchased instead of the current practice of on-site, solution mining. Organic-based chemicals are not presently nor have they ever been used as raw materials or manufactured as products at the RMI Sodium Plant. Sodium peroxide was produced from metallic sodium and air by an oxidation process on an intermittent basis from 1950 to 1979.

In addition to its RCRA Permit (No. OHD000810242), the Sodium Plant operates under an NPDES Permit (No. 31E00012*AD), PSD air permits (Nos. 0204010204 P001, 0204010204 P002, 0204010204 B004, and 0204010204 B005), and solution mining injection well permits (Nos. 2366 and 2367).

The Sodium Plant is composed of a number of manufacturing buildings, warehouse buildings, a general office building, two brine ponds associated with solution mining equipment, five wastewater treatment ponds, fixed storage tanks, product and raw material loading and unloading facilities, active solid waste management units, a closed landfill site, and utility infrastructure. A topographical map which shows the general layout of the Sodium Plant is presented in Figure 2-2.

NOTE: A schematic of the french drain system is shown in figure 3-2. Site surface water drainage patterns are shown in figure 4-23.

100 0 100 200
scale feet

NO.	REVISIONS	REV'D BY	DATE	APPRO'D BY

AWARE INCORPORATED

NASHVILLE, TENNESSEE
MAHWAH, NEW JERSEY

RMI SODIUM PLANT
Ashtabula, Ohio

FIGURE 2-2
TOPOGRAPHIC MAP AND LOCATIONS
OF SWMU'S INCLUDED IN THE
RCRA FACILITY INVESTIGATION

SCALE: 1" = 100'

DRAWN BY	DATE	CHECKED BY	APPROVED BY	DRAWING NUMBER

3.0 FIELD INVESTIGATION METHODOLOGIES

3.1 AERIAL PHOTO SURVEY

Historical aerial photographs of the RMI Sodium plant site were collected and reviewed in order to locate solid waste management units (SWMUs) and their approximate time of operation. In addition, the aerial photographs were reviewed to determine past surface water drainage patterns and land uses of the subject site and surrounding areas. Sixteen aerial photographs, taken over the period from 1949 to 1959, were available and were examined. These photos helped confirm the locations of previous SWMUs on the RMI property as summarized in the figures in the geophysical survey report described below (see also Appendix 1).

3.2 GEOPHYSICAL SURVEY

A surface geophysical survey was conducted over four primary areas of known or suspected waste disposal activities at the RMI Sodium plant site. The purpose of the survey was to define the areas of past waste disposal, and possibly, their effects on groundwater and soil conditions. The results of the survey are included in the "Surface Geophysical Survey, RMI Sodium Plant, Ashtabula, Ohio", prepared by AWARE Incorporated in July 1988, and is attached as Appendix 1.

3.3 SURFICIAL SOIL SAMPLING

Surficial soil sampling was conducted in five areas of the RMI Sodium plant: the fill area north of the wastewater treatment ponds, the fill area west of the wastewater treatment ponds, the fill area northeast of the closed landfill, the fill area northwest of the closed landfill, and the closed landfill. Four surficial soil samples were collected at each location. In addition, 12 surficial soil samples were collected from apparent undisturbed areas across the site to serve as background samples. Therefore, a total of 32 surficial soil samples were collected for analysis, as shown on Figure 3-1.

Sampling of surficial soils was accomplished with clean trowels. A new trowel was used for each sample to avoid cross contamination. Samples were collected at depths ranging from 0 to 4 in. below land surface. Each sample was placed in an appropriate lab container, and placed on ice for shipment to the ECKENFELDER INC. Laboratory in Nashville, Tennessee. The soil samples were analyzed for pH, barium, cadmium, lead, nickel, arsenic, selenium, mercury, silver, and chromium. In addition, one soil sample (SS5-2) was subjected to an organic priority pollutant scan. The results of the surficial soils laboratory analyses are summarized in Section 6.2 of this report.

3.4 SOIL BORINGS

Soil borings were utilized to recover relatively undisturbed soil material at various depths at locations of indicated past waste disposal, adjacent to such waste disposal areas, or in "background" areas. Soil borings were performed at 18 locations across the site. Soil borings were either converted to shallow monitoring wells, deep bedrock monitoring wells, or grouted to land surface upon completion (SB-11 through SB-17). The locations of the monitoring wells and soil borings are indicated on Figure 3-1. The boring logs are contained in Appendix 2.

The soil borings were drilled with a rotary, hollow-stem auger rig. The drilling equipment and augers were cleaned prior to coming onto the site by means of steam cleaning to assure that contamination was not brought from off site. The augers were also steam cleaned between each hole and before leaving the site, at an established decontamination station. All water and steam condensate collected from steam cleaning drilling equipment were placed in drums and subsequently disposed of in the wastewater treatment ponds with the exception of the decontamination wastes from wells 1S and 2S. These wastes were collected in drums and disposed of as hazardous waste by the GSX Company who was working for RMI.

A continuous soil core was recovered by means of the CME continuous-core drilling technique, which utilizes a 5 ft long split barrel, mounted on a drilling rod and positioned such that the cutting edge of the core barrel is slightly in advance of the auger teeth. Thus, the core barrel was advanced into the subsurface by means of hydraulic pressure with the auger section removing material from around the outside of the barrel. Upon completion of 5 ft drilling, the core barrel was removed by the drill rod, without disturbing the auger section. The barrel was then unscrewed and opened. The core was placed on a clean split PVC pipe section and carefully logged by a hydrogeologist. The core was also analyzed with a portable field HNU® photoionization meter to detect the presence of volatile organics. On the well logs in Appendix 2, only HNU readings that were above background were reported. Therefore, the well logs only show HNU readings for wells 1S and 2S because volatile organics were not detected above background in any other core samples with the HNU.

Upon completion of geologic logging, sections of the core were collected and placed into clean plastic containers for transport, on ice, to the ECKENFELDER INC. Laboratory. If HNU readings indicated a need for organic analyses, a portion of the soil sample was placed into glass sample containers for transport to the laboratory. The core barrel was then carefully cleaned by brushing with soap and water, followed by a tap water rinse and a distilled water rinse. It was then reassembled and placed back into the auger for advance through another 5 ft of soil.

During drilling, all cuttings and drill water were collected, placed in new 55 gal drums, and left on site pending the outcome of the laboratory analyses. Based upon depth and visual inspection of each 5 ft soil core, two or three sample intervals from each boring were subjected to chemical analyses for pH; total cyanide; and the metals lead, barium, cadmium, arsenic, selenium, mercury, silver, chromium, and nickel. Three soil samples (1S at 15.1 ft, 2S at 6.0 ft, and 8S at 6.5 ft) were analyzed for volatile organic compounds, base neutral compounds, acid extractable compounds, pesticides, and PCBs. The results of the soils laboratory analyses are summarized in Section 6.2 of this report.

3.5 MONITORING WELL INSTALLATION

3.5.1 Piezometer Installation

Twenty piezometers were installed at key locations throughout the site as shown in Figure 3-1. The piezometers were installed to provide a better definition of shallow groundwater flow. Because information on groundwater flow was essential to the effective placement of monitoring wells, the piezometer installation preceded the final selection of locations for the soil borings and monitoring wells.

Each piezometer was installed by advancing a 6 in. diameter hollow stem auger to a depth of approximately 5 ft below the water table surface (average 15 ft total depth per location). Upon reaching the target depth, a 1.5 in. diameter, 5 ft length of PVC screen was attached to a 1.5 in. diameter PVC riser pipe and inserted into the hole. The annular space around the screen and riser was filled with clean, coarse sand from the base of the screen to 6 in. below ground surface. To divert drainage and stabilize the pipe, the remainder of the annular space was filled with cement grout, mounding the grout around the riser pipe. The construction of the piezometer located in the center of the closed landfill (PZ-9) included the addition of a 2 ft thick bentonite seal placed below the cement grout. This modification served to maintain the integrity of the clay cap present over the closed landfill. The remaining piezometers were not installed in known fill areas. However, the piezometers are intended to be temporary and will be abandoned in the near future.

3.5.2 Shallow Well Installation

Six of the soil borings, described in Section 3.4 of this report, were completed as shallow monitoring wells (1S, 2S, 3S, 6S, 8S, 10S). In addition, shallow wells were installed adjacent to the deeper wells at locations 4S, 5S, 7S, and 9S. The shallow wells were installed to provide information on the water table piezometric surface and the water quality in the glacial till water-bearing zone.

Upon completion of the boring, a 2 in. diameter flush-joint casing string was inserted into the hollow stem auger. This casing string consisted of 10 ft of PVC well screen, with the remainder of the pipe comprised of PVC riser reaching to and extending above the land surface. The casing string in shallow monitoring wells 1S and 2S consisted of Teflon material due to the suspected high levels of organic compounds. The annular space around the well screen was filled with a clean washed silica sand, sized to prevent migration of sand into the well screen section. The sand pack was capped with a seal of bentonite pellets approximately 2 ft thick, which in turn was capped with a neat cement-bentonite slurry grout from the bentonite seal to land surface. A locking steel security cap was placed in the annular space at land surface, and was cemented in by a cement cap approximately 3 ft in diameter at land surface. All shallow wells except 1S and 2S were developed using compressed air at slow rates to prevent any sandpack or formation damage. Monitoring wells 1S and 2S were not developed due to the suspected presence of high concentrations of organic compounds. The boring logs with well construction details are contained in Appendix 2.

3.5.3 Deep Well Installation

Five of the soil borings drilled to the till-bedrock interface, described in Section 3.4 of the report, were drilled into the shale bedrock and completed as deep monitoring wells (4D, 5D, 7D, 9D, and 11D). At four locations (see Figure 3-1), monitoring well "couplets" were constructed, which consisted of one shallow monitoring well, as described in the previous section, together with one deep monitoring well completed in the shale. One bedrock well (11D) was drilled and installed alone in the southwest corner of the plant as a replacement for planned deep monitoring wells 1D and 2D. Wells 1D and 2D, designed as "couplets" with 1S and 2S, were not drilled, to prevent the potential downward migration of suspected high levels of organic compounds into the bedrock zone. These changes were verbally approved by the USEPA.

The deep monitoring wells were carefully completed to assure that contamination was not carried down from overlying material. A 13 in. diameter borehole was advanced, using a hollow-stem auger, approximately 1 to 2 ft into the bedrock through the till/bedrock interface. The hole was carefully cleaned and a 6 in. diameter steel casing was placed in the hole. The steel casing was then grouted in place by filling the annular space between the casing and borehole with a neat-bentonite slurry grout. After the grout was allowed to set, the inside portion of the steel casing was flushed with tap water to minimize the potential for the presence of contaminants inside the steel pipe.

Drilling continued with a roller-cone bit through the lower end of the steel casing to a depth of approximately 18 ft into the shale bedrock. A 2 in. diameter PVC flush jointed casing string was inserted into the borehole. The casing string consisted of 10 ft of PVC well screen, with the remainder of the pipe comprised of PVC riser reaching to and extending above land surface. The annular space around the well screen was filled with a sand pack consisting of clean washed silica sand, and capped by a bentonite pellet seal and neat cement-bentonite slurry grout to land surface. A locking steel security cap was placed over the well at land surface and surrounded by a 3 ft diameter concrete surface seal. All deep wells except 11D were developed using compressed air at slow rates to prevent any sand pack or formation damage. Monitoring well 11D was developed by surging and bailing utilizing a dedicated PVC bailer. The logs for the deep monitoring wells are contained in Appendix 2.

3.6 HYDRAULIC CONDUCTIVITY TESTING

The measure of hydraulic conductivity in the subsurface describes the ability of a rock or soil deposit to transmit water. Hydraulic conductivity beneath a site represents perhaps the most critical parameter in characterizing fluid interaction with the subsurface system. Given sufficient continuity of the strata and known hydraulic gradients, it is the hydraulic conductivity that will control the migration pathways for fluids as well as the volumetric rates of groundwater flow.

In order to determine the in place lateral hydraulic conductivity of the saturated materials, variable head recovery tests were performed on ten selected wells. The field tests involved rapidly lowering the water level in the well and measuring the change in head with respect to time as the well was allowed to recover to static conditions.

It is assumed that the rate of inflow to the well screen after pumping, at any time, is proportional to the hydraulic conductivity (k) and to the unrecovered head distance. A semi-log plot of the unrecovered head distance or head ratio (h_t/h_o, where h_t equals total head and h_o equals initial head) versus time (t) typically indicates an exponential decline in the recovery rate over time.

The following equation is used to calculate the in situ hydraulic conductivity of the saturated materials at the screened interval of the well (Cedergren, 1977).

Where: $$k = \frac{r^2}{2L\,(t_2 - t_1)} \ln(L/R) \times \ln(h_1/h_2)$$

L	=	screen length, in cm
r	=	screen radius, in cm
R	=	gravel pack radius, in cm
t_1	=	time interval corresponding to h_1, in sec
t_2	=	time interval corresponding to h_2, in sec
h_1	=	head ratio at time t_1, dimensionless
h_2	=	head ratio at time t_2, dimensionless
k	=	hydraulic conductivity, in cm/sec

The results of the in situ recovery tests are summarized in Section 4.2.2 of this report.

3.7 GROUNDWATER SAMPLING

Groundwater quality sampling was conducted during two sampling episodes: one from November 16 through 18, 1988 and one from January 11 through 13, 1989.

Monitoring wells were purged by bailing prior to sampling to ensure collection of representative formation samples. The purged groundwater was placed in drums and subsequently disposed of in the wastewater treatment ponds with the exception of purge water from wells 1S and 2S. These waters were collected in drums and disposed as hazardous waste by the GSX Company. The purging effort resulted in the removal of stagnant water stored in the casing and the artificial sand pack surrounding the well screen. The sample obtained after purging thereby represents water introduced directly from the formation to the well as a representative sample of groundwater.

The samples were collected as soon after purging as was practical. Dedicated bailers were used for all monitoring wells. The wells were sampled by the following general method:

- The wells were inspected for any visible damage to the well casing or seal.

- The static water level in each well was measured and recorded. These data and the known dimensions of the well permitted the volume of water in the well to be calculated.

- Each well was purged of at least three well volumes of water or evacuated to dryness, dependent upon the well hydraulics.

- Samples were collected with dedicated bailers.

- pH, specific conductance, and temperature were measured in the field upon collection of each sample.

- Groundwater samples collected for metals analysis were field-filtered through an 0.45 micron membrane filter prior to preservation with nitric acid. Metal results thus obtained are expressed as "dissolved".

- Samples were preserved in accordance with USEPA protocol and shipped on ice to the ECKENFELDER INC. Laboratory in Nashville, Tennessee.

- All monitoring wells, with the exception of wells 1S, 2S, and 7D were analyzed for the following parameters: major ions (calcium, magnesium, sodium, potassium, bicarbonate, carbonate, sulfate, and chloride); dissolved metals (arsenic, barium, cadmium, lead, mercury, selenium, silver, and chromium); conductivity; TDS; pH; and TOC.

Monitoring wells 1S and 2S were not analyzed for the above parameters due to extremely high concentrations of volatile organic compounds. These levels of organics could potentially contaminate the laboratory and equipment and there could be a flammability hazard from other undetected organic constituents when digesting for metals analysis. In addition, any major ions and metals data obtained would be suspect due to interference from these high levels of organic compounds. Monitoring well 7D was analyzed for metals and major cations only, because of insufficient sample due to low water levels in the well.

In addition, monitoring wells 1S, 2S, 4S, and 4D (November 1988 sampling event) and wells 3S, 4S, and 4D (January 1989 sampling event) were subjected to an organic priority pollutant scan which included the following parameters:

- cyanide
- volatile organic compounds
- base neutral compounds
- acid extractable compounds
- pesticides
- PCBs

As discussed in Section 3.5.3, wells 1D and 2D were not installed in order to prevent the downward migration of suspected high levels or organic compounds into the bedrock zone. Groundwater samples from wells 4S and 4D were each subjected to the organic priority pollutant scan as replacements for wells 1D and 2D due to their proximity to the southern property boundary.

The results of the groundwater laboratory analyses are summarized in Section 6.1 of this report. Groundwater field data sheets are contained in Appendix 3.

3.8 WASTEWATER TREATMENT POND SAMPLING

Sampling of the wastewater treatment pond system consisted of three subtasks. The subtasks included sampling of the pond supernatant, sediment, and the collection manholes for the french drain system. This sampling effort was performed by an ECKENFELDER INC. field team on January 31, 1989 through February 2, 1989.

Surface water from each of the five wastewater treatment ponds was collected from two separate locations (see Figure 3-1). Discrete samples (A and B) were collected from the banks of the ponds. A Kemmerer sampling device was used to obtain a water sample from each location. The Kemmerer was lowered into the water to a representative depth as follows: if the water was deep enough at the sample location (greater than approximately 2 ft), the samples were collected at mid-depth; otherwise, the Kemmerer was situated immediately above the pond bottom. These two discrete samples were composited into the appropriate sample container in the field. Compositing was performed on an equal volume basis.

Sediment from each of the wastewater treatment ponds was also collected from two discrete locations. These locations coincided with the discrete water sample locations. Sediment samples were also collected from the bank of the ponds. Attempts were made to sample the sediment utilizing both an Eckman and a Ponar dredge. However, due to the steep grade of the pond sides and to the colloidal size of the inorganic precipitates in the ponds, these two pieces of sampling equipment were ineffective. As such, a scoop consisting of a glass jar connected to a PVC pole was used to collect the discrete sediment samples. The glass jar was dragged along the sides of the ponds scooping up the accumulated sediment. The discrete samples consisted of particle sizes ranging from colloids to small gravel. Each discrete sample was collected in a large glass jar and allowed to settle. The clear water portion was then decanted, the remaining sediment thoroughly mixed, and a representative sample taken from the large jar was placed directly into an appropriate sample container. The sediment samples from the two discrete sample locations were composited into the container on an equal volume basis. In addition, significant settling of the sediment samples occurred during shipment. The clear water portion of the same sample was again decanted prior to analysis.

All sampling equipment for the pond sampling subtasks was decontaminated between ponds using copious amounts of distilled water. Water and sediment samples were appropriately preserved and stored on ice in a cooler prior to shipment to the ECKENFELDER INC. Laboratory. All samples were accompanied by chain-of-custody forms during shipment. Sample preservation and descriptions are contained in Appendix 3.

Waters in the four concrete collection manholes for the french drain system surrounding the wastewater treatment ponds were also sampled (Figure 3-1). The french drain system completely encompasses the wastewater treatment ponds with the exception of a short length near the southeast corner of Pond 5 (see Figure 3-2) . The system consists of a 7 ft deep trench, 14 in. wide, filled with No. 8 washed stone. The trench is covered by a 1 ft thick clay pack to ground surface. A 6 in. diameter perforated PVC pipe lies on the bottom of the trench to conduct the water. Water flows by gravity to one of four collection manholes generally located at the four corners of the pond area. The purpose of the french drain system is to provide a groundwater divide at the periphery of the wastewater treatment ponds. In turn, this groundwater divide is intended to minimize escape of water from the immediate vicinity of the ponds. Groundwater from the shallow zone will also be collected by the french drain system. Water collected by the system in the four manholes is pumped into the nearest wastewater treatment pond and, therefore, the water is intended to be recirculated. Each of the four manholes is equipped with a submersible pump unit. The pumps are equipped with float systems that activate the pumps when water in the manhole rises to a predesignated level and automatically shut off the pumps when the water level is lowered to a second predesignated level. The four collection manholes are located near the southeast corner of Pond 2, the northeast corner of Pond 4, the west side of Pond 5, and the southwest corner of Pond 1 (see Figure 3-2).

None of the manholes could be sampled with a dipper as originally planned because of the configuration of the manhole cover and the permanent pump installed in the manhole. Therefore, water in three of the four french drain collection manholes was sampled utilizing a small electric centrifugal pump. Water was collected directly into the appropriate sample containers. Samples were appropriately preserved and stored on ice in a cooler prior to shipment to the ECKENFELDER INC. laboratory. All samples were accompanied by chain-of-custody forms during shipment. The pump and tubing were primed and decontaminated using distilled water between manholes. Water was pumped for a short period of time prior to sample collection to purge the distilled water used to prime the pump. The water level in the manhole near Pond 5 was too low to use the centrifugal pump. As such, a plant employee activated the permanent pump installed in the manhole and a water sample was collected from the discharge pipe which is connected to the permanent pump and discharges into Pond 5. The glass jar used for pond sediment sampling was attached to a PVC pole in order to obtain the sample. The discharge was allowed to flow a short time prior to sample collection to purge any potentially accumulated material in the discharge pipe. The liquid which was sampled in this way is the liquid that entered the manhole via the french drain system and is analogous to the samples collected from the other manholes. The glass jar used for sample collection was rinsed with copious amounts of distilled water prior to sample collection. Sample preservation and descriptions are contained in Appendix 3.

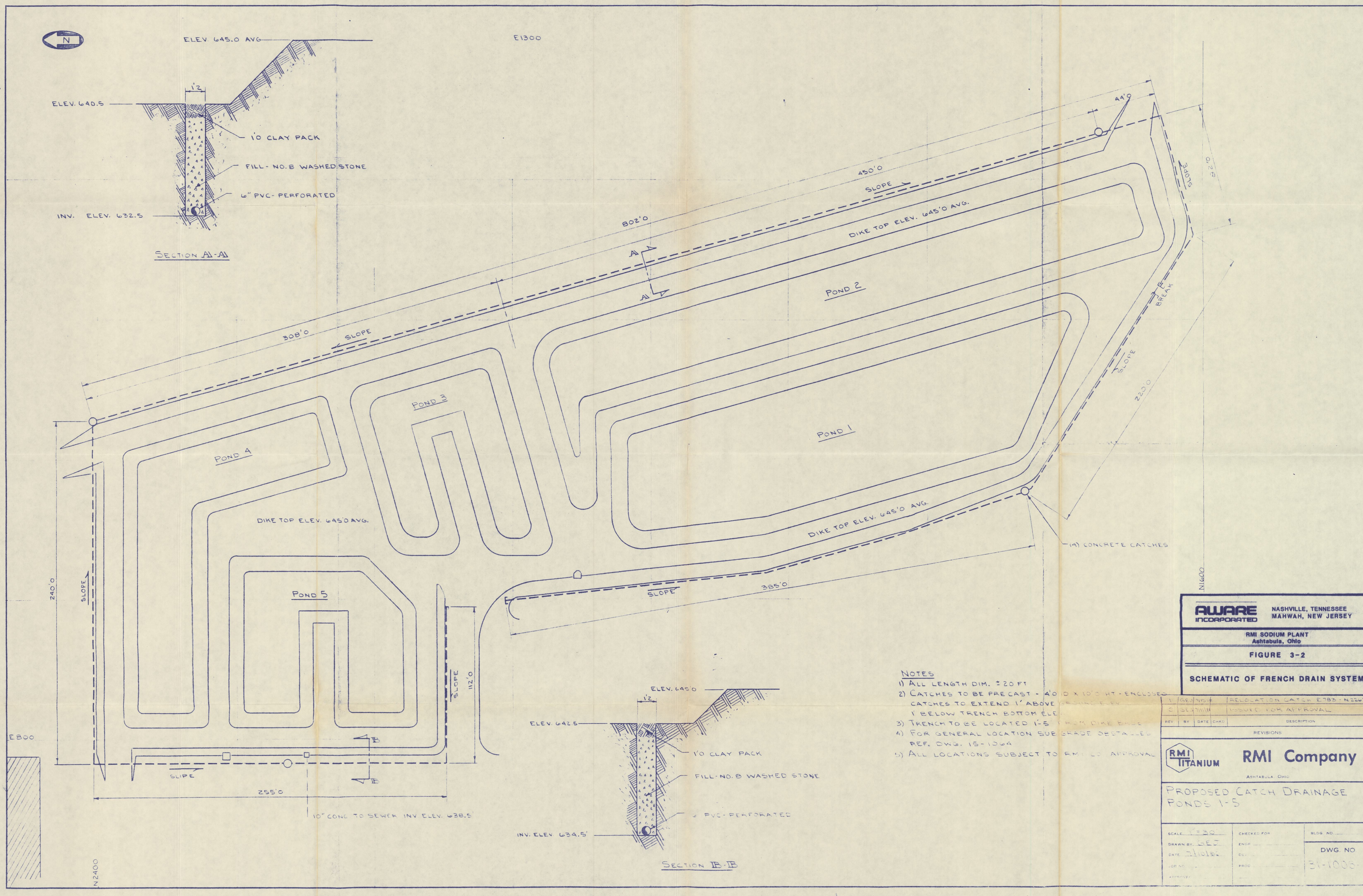
Prior to and during the above described sampling subtasks, air monitoring utilizing the HNU photoionizing probe and Draeger tubes was conducted. Results of monitoring using the HNU indicated no quantitative organic concentrations above background. Two Draeger tubes were utilized for air monitoring for chlorine during the sampling of the wastewater treatment ponds. In both instances, chlorine presence was indicated by an unquantifiable detection in the Draeger tube. Discoloring was observed at the zero line of the tube in each instance.

3.9 SURFACE WATER SAMPLING

Surface water in the drainage ditch system located on the southern portion of the RMI property was sampled at seven locations (see Figure 3-1). Due to the shallow depth of water in the ditches, samples were collected using the glass jar and PVC pole set-up used for pond sampling. Collected water was placed directly into the appropriate sample container. Sample containers were appropriately preserved and stored on ice in a cooler prior to shipment to the ECKENFELDER INC. Laboratory. All samples were accompanied by chain-of-custody forms.

The drainage ditch system sampled during this subtask is located in the vicinity of the closed landfill on the southeast portion of the RMI property. Three samples (E, F, G) were collected from what has been labeled the DS tributary. The other four samples (A, B, C, D) were collected from a feeder to the DS tributary. (Prior to closure of the landfill, the DS tributary flowed across the area now occupied by the closed landfill. During closure of the landfill, the DS tributary was rerouted such that it flows around the landfill to the north). In part, the ditch is used to convey stormwater runoff from the RMI property. It also receives stormwater runoff from other adjacent properties. In addition, the ditch system is believed to be a discharge point for portions of the shallow groundwater beneath the property.

Adequate flow was observed at five of the seven ditch sample locations. Sample points E and F consisted of standing water. While it is believed that the ditch segment represented by locations E and F conveys measurable flow during periods of precipitation, no flow was observed during sampling. The main flow path of the ditch was from points D to C to A to G. Sample G was collected in the ditch immediately before the ditch flowed under the RMI property south fence line, and therefore, off site. Sample D was located in a topographically low area near the water tower. Vegetation in the area suggested that this area is wet much of the year. However, there is a well defined ditch system within this area. The water source for this ditch appeared to originate off site. Sample B was collected in a ditch segment which appears to originate from the process areas of the plant. This ditch segment was observed to have both a light colored and a red-brown fine material on the bottom of the ditch. The specific origin of sediment in this ditch location is unknown, but is likely to be the result of runoff and/or erosion of portions of the plant north of the ditch sample location. It should be noted that the red-brown fine material is believed to be an inorganic precipitate, probably resulting from the oxidation of iron. A summary of sample preservation and location descriptions is contained in Appendix 3.



N
ELEV. 645.0 AVG
1'2
ELEV. 640.5
1'0 CLAY PACK
FILL - NO. 8 WASHED STONE
6" PVC - PERFORATED
INV. ELEV. 632.5
SECTION A1-A1
E1300
44'0
450'0
SLOPE
802'0
DIKE TOP ELEV. 645'0 AVG.
A1
A1
SLOPE
82'0
BREAK
POND 2
308'0
SLOPE
SLOPE
220'0
POND 3
POND 1
POND 4
DIKE TOP ELEV. 645'0 AVG.
DIKE TOP ELEV. 645'0 AVG.
(4) CONCRETE CATCHES
240'0
SLOPE
POND 5
SLOPE
385'0
N1600
112'0
SLOPE
B
B
SLIPE
255'0
E800
10" CONC TO SEWER INV ELEV. 638.5
N2400
ELEV. 645.0
1'2
ELEV. 642.5
1'0 CLAY PACK
FILL - NO. 8 WASHED STONE
PVC - PERFORATED
INV. ELEV. 634.5'
SECTION B-B
NOTES
1) ALL LENGTH DIM. ±20 FT
2) CATCHES TO BE PRECAST - 4'0 ID x 10'0 HT - ENCLOSED
CATCHES TO EXTEND 1' ABOVE GROUND ELEV
1' BELOW TRENCH BOTTOM ELEV.
3) TRENCH TO BE LOCATED 1'-5' FROM DIKE BASE
4) FOR GENERAL LOCATION SUB GRADE DESTAILLES
REF. DWG. 15-1064
5) ALL LOCATIONS SUBJECT TO RMI CO APPROVAL
AWARE INCORPORATED
NASHVILLE, TENNESSEE
MAHWAH, NEW JERSEY
RMI SODIUM PLANT
Ashtabula, Ohio
FIGURE 3-2
SCHEMATIC OF FRENCH DRAIN SYSTEM
1 GEJ 7/15/81 RELOCATION CATCH E783 - N2263
0 GEJ 7/11/81 ISSUED FOR APPROVAL
REV. BY DATE CHKD DESCRIPTION
REVISIONS
RMI TITANIUM
RMI Company
ASHTABULA, OHIO
PROPOSED CATCH DRAINAGE
PONDS 1-5
SCALE 1"=30'
DRAWN BY GEJ
DATE 7/10/81
JOB NO.
APPROVED
CHECKED FOR
ENGR
DEV
PROD
BLDG. NO.
DWG. NO
31-1006-

4.0 ENVIRONMENTAL SETTING

4.1 REGIONAL GEOLOGY AND HYDROGEOLOGY

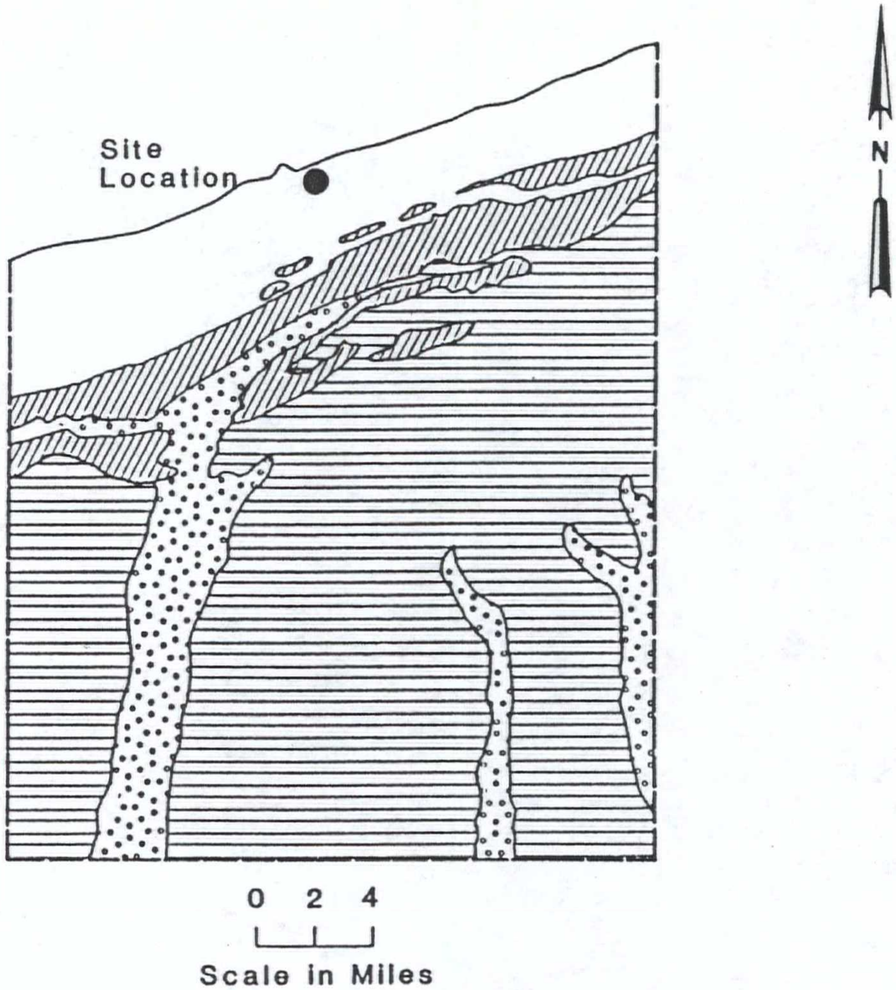
4.1.1 Physiography

Ashtabula County is situated in two contrasting major physiographic provinces: the Lake Plain of the Central Lowland Province and the Allegheny Plateau of the Appalachian Plateau Province (Figure 4-1). A one to three mile wide escarpment of Mississippian bedrock overlain by glacial moraines separates the Lake Plain from the higher Allegheny Plateau to the south (White and Totten, 1979).

The RMI site is located on the Lake Plain, a belt about 3 to 5 ½ miles wide adjacent to Lake Erie. Oriented parallel to the present shoreline is a series of sandy and gravelly ridges representing beaches of earlier lakes which occurred at higher water levels than the present Lake Erie water level. The most prominent of these ridges is the North Ridge (the beach of the ancient Lake Warren) and the South Ridge (the beach of glacial Lake Whittlesey). Except for these beaches of ancient lakes, the Lake Plain is relatively flat and characterized by poor drainage. Bedrock (the Devonian age Chagrin Shale) is close to the surface over much of the Lake Plain and is exposed in almost all of the stream valleys (White and Totten, 1979).

4.1.2 Bedrock Geology

At a depth of 8,000 to 10,000 ft, the Precambrian basement complex of crystalline rocks (granite, gneiss, schist, marble, metavolcanics, and related rock types) form the base of the geologic bedrock section in northern Ohio. These rocks are believed to be the remains of the roots of an ancient mountain system which was formed about 1,000 million years ago. Overlying the basement



Adapted From White And Totten, 1979
(By Dames & Moore, 1987)

LEGEND:

- LAKE PLAIN
- ESCARPMENT BELT (With Moraines)
- PLATEAU
- INCISED RIVER VALLEY

RMI SODIUM PLANT
Ashtabula, Ohio

FIGURE 4-1

PHYSIOGRAPHIC REGIONS OF ASHTABULA COUNTY

ECKENFELDER INC.
Nashville, Tennessee
Mahwah, New Jersey

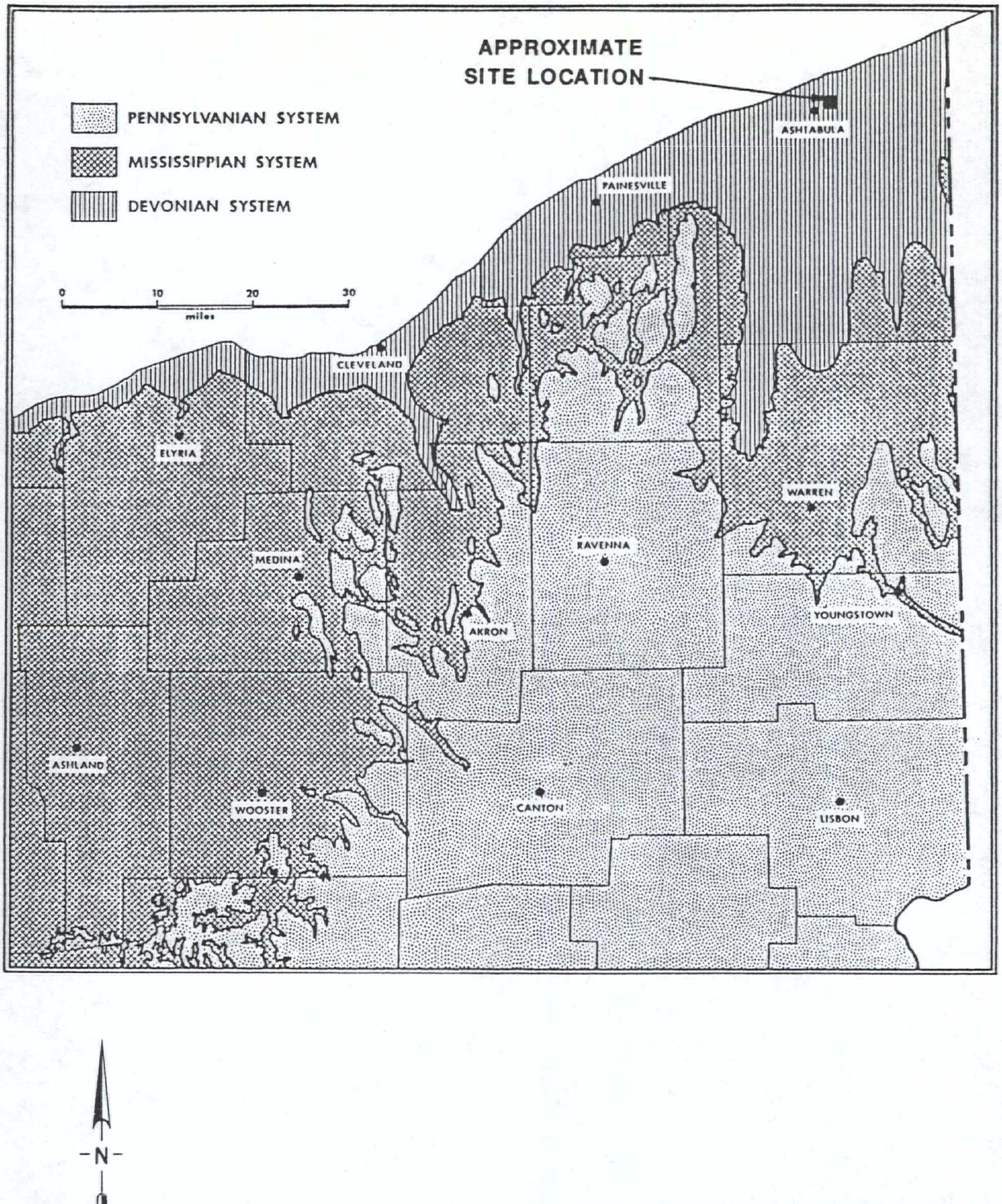
are lithified sediments (sands, muds, and limey materials) which were deposited in the shallow, epicontinental seas that covered the continental interior during the Paleozoic era (Banks and Feldmann (eds.), 1970).

The bedrock unit underlying the RMI site is the Devonian Chagrin Shale, which is a relatively soft, blue-gray fossiliferous shale with occasional thin siltstone layers (Figure 4-2). The formation is an immense sedimentary wedge that thickens eastward to a maximum of 1,200 ft in Ashtabula County. The unit thins to approximately 500 ft at Cleveland and thins rapidly and gradually loses its identity in Huron and Erie Counties. The Chagrin Shale is underlain by Devonian limestone and the Silurian Salina Formation which is composed of carbonates, shale, and evaporites. (Banks and Feldmann (eds.), 1970).

4.1.3 Unconsolidated Deposits

During the Pleistocene Epoch, glaciers moved to the southwest out of the Lake Erie basin, forming a series of unconsolidated deposits overlying the bedrock throughout Ashtabula County. Glacial deposits (till) consisting of an unsorted mixture of the clay, silt, sand, pebbles, cobbles, and boulders were deposited directly by the ice. Water flowing from the melting ice deposited finer material (outwash deposits) that is stratified and sorted. Both till and outwash deposits are present in Ashtabula County (White and Totten, 1979).

Ashtabula County is covered by Pleistocene glacial deposits of at least seven continental ice sheets. The RMI site is underlain by Wisconsin Stage till deposits, which are the most recent deposits of glacial history. These deposits were laid down as part of the Grand River Lobe (Figure 4-3), which advanced southward from the Lake Erie basin. The tills generally overlie the bedrock, sometimes separated by the presence of a weathered bedrock surface, and in turn are occasionally overlain by localized deposits of silt derived from wave washing and reworking of the till (White and Totten, 1979).



SOURCE : Banks and Feldmann (eds.), 1970

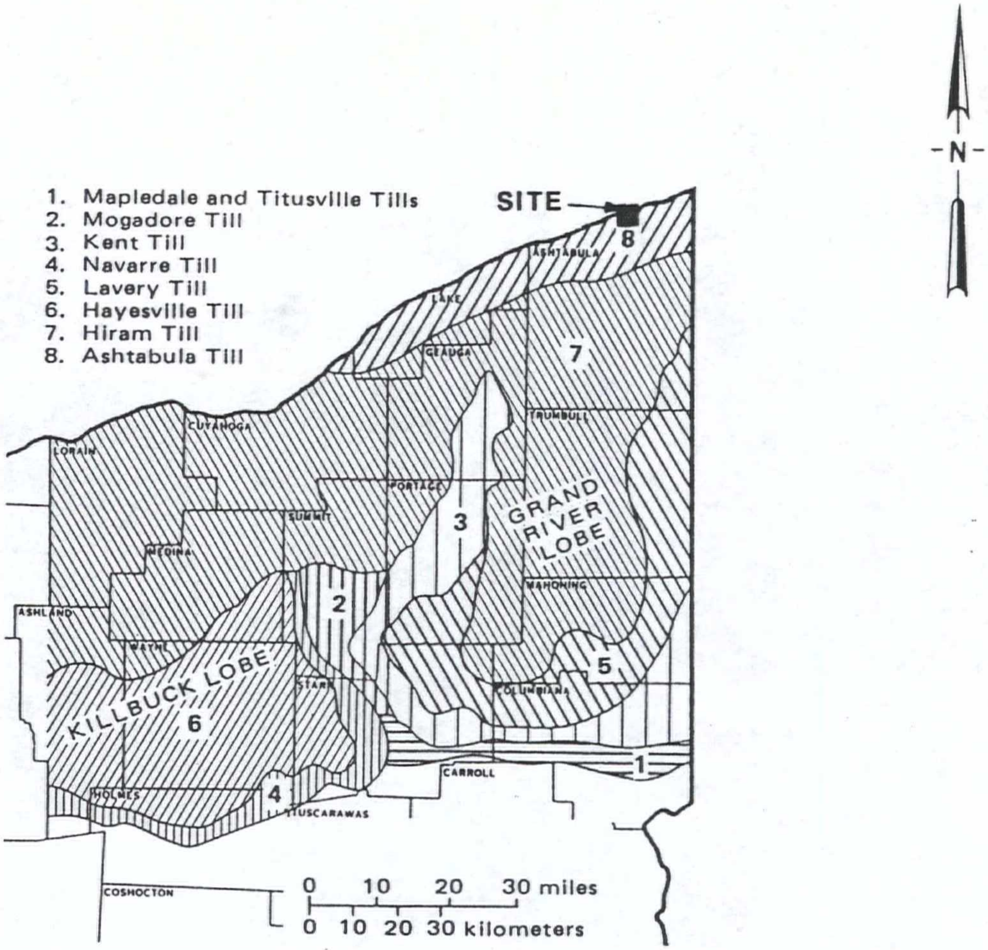
RMI SODIUM PLANT
Ashtabula, Ohio

FIGURE 4-2

BEDROCK GEOLOGY OF NORTHERN OHIO

ECKENFELDER INC.

Nashville, Tennessee
Mahwah, New Jersey



SOURCE : White and Totten, 1979.

RMI SODIUM PLANT
Ashtabula, Ohio

FIGURE 4-3

GLACIAL LOBES AND TILL IN NORTHERN OHIO

ECKENFELDER INC. Nashville, Tennessee Mahwah, New Jersey

As shown in Figure 4-3, the RMI Site is underlain by Ashtabula Till deposits, the youngest of the Wisconsin Stage till deposits. The Ashtabula Till is a calcareous silty clay till, sparingly to moderately pebbly. Cobbles and boulders may also be present. The lower part of the till contains layers or pods of silt and clay and pieces of "smeared" shale in the matrix of the till. The Ashtabula till overlies older, undifferentiated tills overlying the bedrock (Figure 4-4) (White and Totten, 1979).

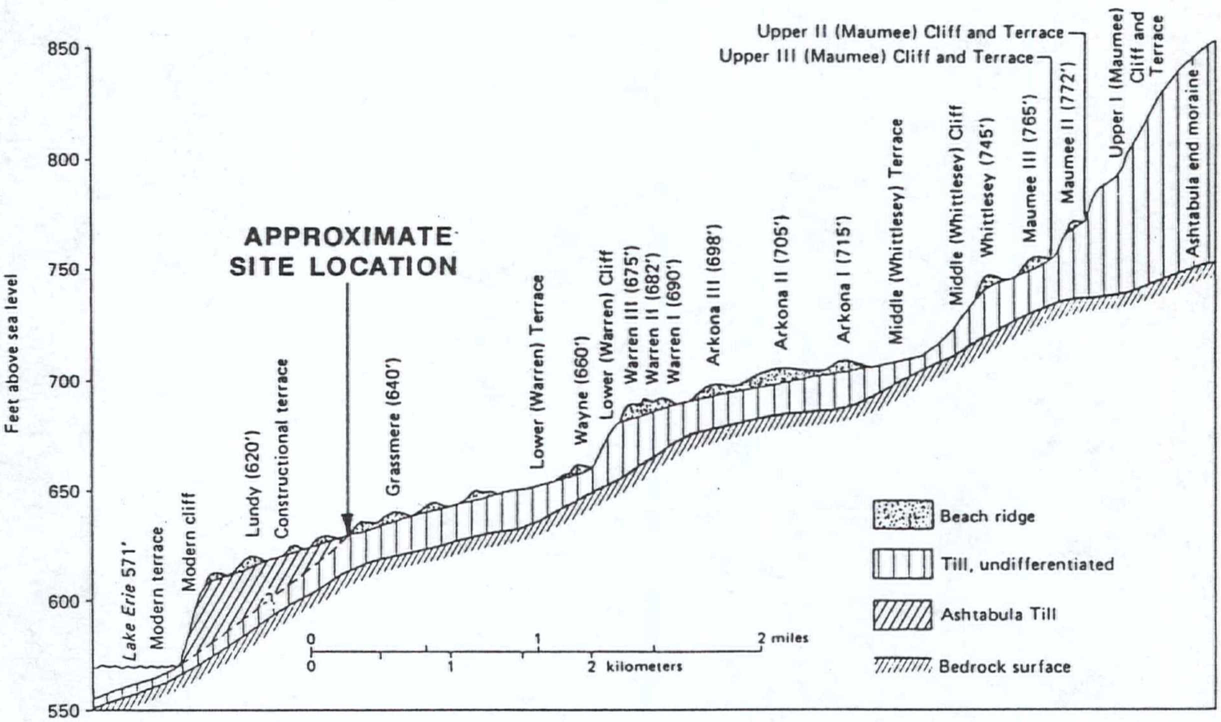
4.1.4 Hydrogeology and Groundwater Use

The regional water table occurs at approximately 2 to 10 ft depths in the low permeability lacustrine and glacial till deposits of the Lake Plain Belt. This shallow water table is a result of the impervious nature of both the soils and underlying shale bedrock. Regionally, the groundwater flow direction is expected to be northward toward Lake Erie. Locally, groundwater flow is generally toward rivers and tributaries.

The regional hydrogeology of the RMI site is characterized by low groundwater yields from both bedrock and surficial materials, as a result of extremely low permeability. The area in the vicinity of the RMI site is a poor area for developing even minimal domestic supplies (Hartzell, 1978).

Except for the City of Orwell in the southwestern portion of the county (approximately 15 miles away), all of the municipalities in Ashtabula County utilize Lake Erie or river impoundments (reservoirs) as public water supply sources. Ashtabula receives its water from Lake Erie via the Ashtabula Water Works Company. (Personal Communication, 1989, Jim Raab, Ohio Department of Natural Resources). There is no dependence on groundwater at or near the RMI site.

Because the till and bedrock in the vicinity of the RMI site are poor sources of water, there are few domestic wells and are no municipal wells in the area. The domestic wells generally yield less than 5 gpm (Personal Communication, 1989, Jim Raab, Ohio Department of Natural Resources).



NOTE : Elevations of beach ridges are for the western border of the county; many elevations rise to the east.

SOURCE : White and Totten, 1979.

RMI SODIUM PLANT
Ashtabula, Ohio

FIGURE 4-4

COMPOSITE CROSS SECTION OF NORTHERN ASHTABULA COUNTY

ECKENFELDER INC.
Nashville, Tennessee
Mahwah, New Jersey